CLAIMS:

1. A layered organic-inorganic oxide material comprising or including:
   - one or more layers of metal oxide consisting of one or more atomic planes of corner-shared MO_6 octahedra, where M is the metal, and
   - one or more layers of organic molecules,

   wherein the metal-oxide layers alternate with one or more organic layers alternate to form a periodic planar structure.
2. A material as claimed in claim 1 wherein the metal M is W, V or Mo, or a combination of these.
3. A material as claimed in claim 2 wherein the metal M is metal M is W, V or Mo, or a combination of these and wherein other high valency metals such as Ti, Nb, Ta, Ru and Re are used in partial combination with Mo, W or V.
4. A material as claimed in claim 2 or 3 having a general formula $X.M_mO_{3m+1}$ wherein M is the metal, and X is an organic cation and m=1, 2, 3.
5. A material as claimed in claim 4 wherein the organic cation is bidentate.
6. A material as claimed in claim 5 wherein the configuration of organic layer relative to the inorganic layer is eclipsed.
7. A material as claimed in claim 5 or 6 wherein the organic cation is a diammonium cation, the material is of composition $NH_3.A.NH_3.M_mO_{3m+1}$.
8. A material as claimed in claim 7 wherein m=1, such that each inorganic oxide atomic plane alternates with an organic layer.
9. A material as claimed in claim 8 wherein m=2, the composition is $NH_3.A.NH_3.M_2O_7$ and wherein the organic oxide exists as a double atomic plane layer of corner shared MO_6 octahedra, such that the material has the stacking structure $-A-O-MO_2-O-MO_2-O-A$.
10. A material as claimed in claim 8 or 9 wherein the organic cation is an aliphatic diammonium cation, and $A = (CH)_n$, n= 1,2,...... .
11. A material as claimed in claim 10 wherein, on the organic cation the ammonium cation groups are positioned on the terminal alkane units of A.
12. A material as claimed in claim 11 having the chemical formula $NH_3(CH_2)_nNH_3MO_4$.
13. A material as claimed in claim 12 with n=2.
14. A material as claimed in claim 12 with n=6.

15. A material as claimed in claim 12 with n=12.
16. A material as claimed in claim 8 or 9 wherein the organic cation is an aromatic diammonium cation.
17. A material as claimed in claim 16 wherein A = C_6H_4 and the organic cation is $NH_3C_6H_4NH_3$.
18. A material as claimed in claim 16 wherein the organic cation comprises an aromatic ring with two aliphatic side chains of equal or unequal length each side chain terminated by an ammonium ion, the organic cation having the general formula $NH_3(CH_2)_n C_6H_4(CH_2)_mNH_3$.
19. A material as claimed in claims 17 or 18 in which adjacent aromatic rings are crosslinked to form an organic polymer layer.
20. A material as claimed in claim 19 in which the organic polymer layer is conducting.
21. A material as claimed in claim 2 or 3 having a general formula $X'_2.M_mO_{3m+1}$ wherein M is the metal, and X' is an organic cation and m=1, 2, 3.
22. A material as claimed in claim 21 wherein the organic cation is monodentate.
23. A material as claimed in claims 21 or 22 wherein the configuration of organic layer relative to the inorganic layer is staggered.
24. A material as claimed in claim 23 wherein both organic cations are monoammonium cations and the material is of composition $(NH_3.A')_2.M_mO_{3m+1}$.
25. A material as claimed in claim 24 wherein m=1, such that each inorganic oxide atomic layer alternates with an organic layer.
26. A material as claimed in claim 24 wherein m=2, the composition is $(NH_3.A')_2.M_2O_7$ and wherein the organic oxide exists as a double atomic plane layer having approximately the ZWO_3 perovskite structure with the Z sites vacant such that the material has the stacking structure $NH_3.A'$-MO_2-O- MO_2-$A'.NH_3$.
27. A material as claimed in claim 25 or 26 wherein one or both organic cation is an aliphatic ammonium cation, and A' = $(CH)_n$, n= 1,2,...... ..
28. A material as claimed in claim 25 or 26 wherein one or both organic cation is an aromatic ammonium cation.
29. A material as claimed in claim 28, wherein the aromatic ring has a side chain which is aliphatic and terminated by an ammonium ion, having the formula $(C_6H_5.(CH_2)_mNH_3)_2MO_4$ where m=0, 1, 2, 3,...

30. A material as claimed in claim 28 or 29 in which adjacent aromatic rings are crosslinked to form an organic polymer layer.

31. A material as claim in any one of the preceding claims in which the organic polymer layer is conducting.

32. A material as claimed in any one of the preceding claims wherein dopants are introduced into the structure.

33. A material as claimed in claim 32 wherein the dopant is selected from one or more of an alkali cation a methylammonium cation, replacing ammoinium groups, field-effect injected electrons or field-effect injection electron holes.

34. A material as claimed in claim 32 wherein the dopant is present in the inorganic oxide layers and the doping state of the oxide is adjusted such that the oxide exhibits superconductivity above the temperature of 40K.

35. A material as claimed in claim 32 where the doping state of the oxide is adjusted such that the oxide exhibits superconductivity above the temperature of 90K.

36. A material of any one of the preceding claims in which M is partially or fully substituted by a magnetic transition metal ion so as to display magnetically ordered states.

37. An organic/inorganic oxide material of any of claims 1 to 33 in which the oxide layer comprising MO_4, M_2O_7 or M_mO_{3m+1} is wholly replaced by any of the following oxide layers CuO_2, NiO_2, CoO_2, CuO_2CaCuO_2, $Ca_{m-1}Cu_mO_{2m}$, m=1, 2, 3,..., NiO_2CaNiO_2, $Ca_{m-1}Ni_mO_{2m}$, m=1, 2, 3,..., square pyramidal MnO_3, square pyramidal RuO_3, octahedral RuO_4, O-MnO_2-Y-MnO_2-O, O-MnO_2-Ca-MnO_2-O, O-RuO_2-Y-RuO_2-O, or O-RuO_2-Ca-RuO_2-O.

38. A layered organic-inorganic oxide material comprising or including:

- One or more layers of metal oxide consisting of one or more atomic planes of metal oxide having substantially the ZMO_3 perovskite structure (M=metal) with the Z sites vacant, and
- one or more layers of organic molecules,

wherein the metals form divalent cations and are coordinated into a corner-shared square-planar structure, or wherein the metals form tetravalent cations and are coordinated into a corner-shared square-pyramid structure,

wherein one or more metal-oxide layers alternate with one or more organic layers alternate to form a periodic planar structure.

39. A material as claimed in claim 38 wherein the metal, M, is Cu, Ni, Ru, Mn, or a combination of these.

40. A material as claimed in claim 39 wherein higher order structures are formed with two or more oxide layers each separated by an alkali earth ion which is situated in the perovskite A-site.

41. A material as claimed in claim 40 wherein the alkali earth ion is calcium.

42. A material as claimed in claim 41 having the general formula of one of: $NH_3.A.NH_3CuO_2$, $(A.NH_3)_2CuO_2$, $NH_3.A.NH_3Ca_{m-1}Cu_mO_{2m}$, m=1, 2, 3,..., $(A.NH_3)_2Ca_{m-1}Cu_mO_{2m}$, m=1, 2, 3,..., $NH_3.A.NH_3NiO_2$, $(A.NH_3)_2NiO_2$, $NH_3.A.NH_3Ca_{m-1}Ni_mO_{2m}$, m=1, 2, 3,..., $(A.NH_3)_2Ca_{m-1}Ni_mO_{2m}$, m=1, 2, 3,..., and $NH_3.A.NH_3MnO_3$, $(A.NH_3)_2MnO_3$, $NH_3.A.NH_3Ca_{m-1}Mn_mO_{2m+2}$, m=1, 2, 3,..., $(A.NH_3)_2Ca_{m-1}Mn_mO_{2m+2}$, m=1, 2, 3,..., $NH_3.A.NH_3RuO_3$, $(A.NH_3)_2RuO_3$, $NH_3.A.NH_3Ca_{m-1}Ru_mO_{2m+2}$, m=1, 2, 3,..., $(A.NH_3)_2Ca_{m-1}Ru_mO_{2m+2}$, m=1, 2, 3,....

43. A material as claimed in any one of claims 38 to 42 wherein dopants are introduced into the structure.

44. A material as claimed in claim 43 wherein the dopant is selected from one or more of an alkali cation a methylammonium cation, replacing ammoinium groups, field-effect injected electrons or field-effect injection electron holes.

45. A material as claimed in claim 44 wherein the dopant is present in the inorganic oxide layers and the doping state of the oxide is adjusted such that the oxide exhibits superconductivity above the temperature of 40K.

46. A material as claimed in claim 44 where the doping state of the oxide is adjusted such that the oxide exhibits superconductivity above the temperature of 90K.

47. A material one of claims 38 to 46 in which M is partially or fully substituted by a magnetic transition metal ion so as to display magnetically ordered states.

48. A method of preparing a layered inorganic-organic material which comprises or includes:

- one or more layers of metal oxide, and
- one or more organic layers,

wherein the layers exist substantially in a perovskite structure, the method comprising or including the steps of contacting a source of metal and/or oxide with a source of the organic layer such that the layer structure substantially self assembles.

49. A method as claimed in claim 48 wherein the material is of the general structure $NH_3.A.NH_3.M_mO_{3m+1}$ and is prepared either:
   - by reaction of a diaminoalkane with tungstic acid (when the metal is W) or molybdic acid (when the metal is Mo), or
   - by dissolution of tungstic acid (when the metal is W) or molybdic acid (when the metal is Mo) ammonia solution, or
   - by reaction of W or Mo metal with hydrogen peroxide

50. A layered inorganic-organic material prepared substantially according to the above method.

51. A method of preparing a layered inorganic-organic material comprising or including
   - One or more layers of metal oxide consisting of one or more atomic planes of metal oxide having substantially the ZMO_3 perovskite structure, or derivatives/analogues thereof (M=metal) with the Z sites vacant, and
   - one or more layers of organic molecules,

   wherein one or more metal-oxide layers alternate with one or more organic layers alternate to form a periodic planar structure,

   and wherein the spacing and electronic coupling between adjacent but separation inorganic layers can be preselected by choice of appropriate organic molecule.

52. A layered inorganic-organic material prepared substantially according to the method of claim 51